UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
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EPD 422/3 - Rekabentuk Sistem Pembuatan

Masa : 3 jam

ARAHAN KEPADA CALON :

Sila pastikan bahawa kertas soalan ini mengandungi **LAPAN (8)** mukasurat dan **ENAM (6)** soalan yang bercetak sebelum anda memulakan peperiksaan.

Soalan terbahagi kepada **DUA (2)** bahagian.

BAHAGIAN A

MENGANDUNGI TIGA (3) SOALAN KAJIAN KES DAN CALON WAJIB MENJAWAB SEMUA SOALAN.

BAHAGIAN B

MENGANDUNGI TIGA SOALAN DAN CALON DIKEHENDAKI MENJAWAB HANYA DUA (2) SOALAN.

Calon boleh menjawab semua soalan dalam Bahasa Malaysia. Jika calon ingin menjawab dalam Bahasa Inggeris sekurang-kurangnya **SATU (1)** soalan perlu dijawab dalam Bahasa Malaysia.

Setiap soalan mestilah dimulakan pada mukasurat yang baru.

Bahagian A (*Section A*): Sila jawab SEMUA soalan pada bahagian ini.

Sila baca fakta kajian kes dengan teliti dan kemudian jawab semua soalan dalam bahagian ini. Pastikan anda menjawab soalan secara berturutan.

LEAN ENGINEERING SDN. BHD.
MANUFACTURING OPERATION ANALYSIS

1.0. BACKGROUND

Lean Engineering Sdn. Bhd. (LESB) is a company specialising in die, mould and tooling. LESB also is taking orders to manufacture all sorts of engineering parts and components. The utilisation of CNC machines had made LESB to have the competitive edge in producing high accuracy of engineering components. Based on the forecast report from LESB Marketing/Sales department, the trend of demand for engineering components will increase 50% (from the 2006 year demand) in the year 2007. LESB intend to improve their capacity and operation efficiency to meet customer requirement. From the 2006 Annual Key Performance Index (KPI) report from every department in LESB indicates that the Purchasing and Finance department (PF) and Production Processing department (PP) is not meeting the required KPI. That was the first time LESB were not able to meet their normal capacity i.e. producing 500,000 components per annum. This had reduce the capability of LESB to take more orders in the year 2007, hence denying LESB to increase their revenue.

2.0. OBJECTIVES OF IMPROVEMENT

- To reduce the lead time hence increasing the throughput
- To reduce work in progress (WIP) that will reduce high inventory
- To improve quality and supplier commitment
- To improve working technique and increase productivity
- To reduce the man power cost and material cost that will increase profit

3.0. CURRENT OPERATION

LESB runs only one (1) shift per day (8 hours/shift) for twenty (20) days/month. Following are the departments in LESB.

DEPARTMENT	WORKFORCE
Administration & Human Resouces (AHR)	5 workers
Purchasing & Finance (PF)	5 workers
Sales & Marketing (SM)	5 workers
Production Processing (PP)	6 workers
Maintenance Engineering (ME)	5 workers
Quality Assurance & Control (QAC)	5 workers

AHR is providing the public relations matter, organisation management and personnel management. PF deals with the purchasing and payment of all the items need by LESB. SM is managing all the sales and marketing task, including shipment of manufactured parts to the customers. PP is doing the manufacturing of the engineering components that will later inspected by the QAC. In case of any breakdown, ME will be responsible and if it is beyond their capabilities, the external consultant will be appointed to assist the breakdown.

Another constraint is that a worker can only work up to 16 hours/day (normal working hour plus 8 hours overtime). The labour law had stated that a worker must have minimum 8 hours of rest before commencing work after a 16 hours of work.

4.0. OBSERVATION AND FINDING

a) From the year 2006 KPI report, the order of engineering component is 504,000 pieces per annum.
b) Total annual profit before tax ended year 2006 for LESB is RM5,150,000.00 millions. Tax payment per annum is about RM110,000.00.
c) The 2006 KPI report, PF cannot meet the target due to vendor supplying the material is usually unable to meet the delivery date.
d) PP also cannot meet the target output because they a having quality problem from the low quality material. This happened because LESB is pushing vendor to provide material at low cost, therefore the vendor is supplying a 2nd grade material to meet the low cost requirement.
e) Production of engineering parts is quite simple because it requires the utilisation of drilling and grinding machines respectively. To minimise overhead, LESB only have 3 drilling machines and 3 grinding machine.
f) LESB utilise FIFO scheduling technique and upon completion of drilling, all WIP parts will be handed over to the grinding section for finishing operation.
g) Productive hours available per shift are only 7 hours (1 hour lunch break).
h) Based from the time study, drilling process requires 3 minutes per component and another 2 minutes per component for internal grinding process. Therefore, a total of 5 minutes per component is required for machining
i) From the study also shows that to meet the production of 504,000 pieces in year 2006, PP had to do overtime that cost them about RM172,800.00 per annum due to rework and late delivery of material from vendors.
j) Labour cost is RM10.00 per hour and overtime rate is RM20.00 per hour.
k) Product cost is RM10.00 per unit and outsourcing of the product will cost RM16.00 per unit.

5.0. PROPOSED IMPROVEMENT

PF had come up with a survey to the top management to reevaluate the vendors i.e. Waja, Satria or Tiara based on three vendor criteria i.e. quality, delivery and cost. Based on past record each vendors have their own strength; Waja is well known for its quality products, Satria can delivery parts at a very minimal time whereas Tiara can produce components at a very minimal cost. A feedback received from the top management that their preferences are as the following i.e. quality of the component (extremely preferred than delivery period), delivery period (strongly preferred than cost) and cost of the component (moderately preferred than quality). PF did an evaluation based from the year 2006 peformances of their vendors with the following preferences;

- For the quality criteria, Waja was extremely preferred than Satria and Tiara, whereas Satria on the other hand was strongly preferred than Tiara.

- Delivery criteria was extremely preferred for Satria compared to Waja. Comparison between Satria and Tiara showed that Satria was strongly preferred than Tiara. For comparison with Waja, Tiara was very strongly preferred.

- For the cost criteria, Tiara was was extremely preferred than Waja and Satria, whereas for Waja, it was moderately preferred than Satria.

PP is also suggesting to utilise Laser Beam Machining (LBM) which will eliminate the need of drilling machining time and internal grinding process time can be reduce. The cost to purchase the LBM is RM 455,000.00 per unit. Feasibility study in application of LBM process shows that the total machining time per component including grinding is 3 minutes per component.

UNTUK TUJUAN PENGIRAAN SAHAJA: Abaikan masa *"set-up"*, abaikan masa penghantaran/pergerakkan/pemindahan komponen daripada mesin ke mesin. Sila anggap tidak ada produk yang terbuang atau produk rosak yakni "Kecacatan Sifar". Jika anda membuat sebarang andaian untuk sesuatu pengiraan yang dibuat, SILA NYATAKAN DENGAN JELAS mengapa andaian tersebut penting. Tunjukkan jalan pengiraan anda secara teratur.

***FOR CALCULATION PURPOSE ONLY**; Please ignore set-up time, omit the time for delivery/moving/transferring time of the component from machine to machine. Assume there are no product waste or reject product i.e. "Zero Defect". If you make assumption for any given calculation, **PLEASE STATE CLEARLY** why the assumption is important. Show all the calculation steps appropriately.*

Anda telah dilantik sebagai perunding untuk membuat analisa secara terperinci dan mengenalpasti langkah terbaik untuk mencapai "Objective of Improvement" yang telah disenaraikan. Maka, tugas anda adalah untuk menerangkan dan menjawab semua persoalan tentang rekabentuk sistem pembuatan seperti yang disenaraikan dibawah.

You are appointed as a consultant to carried out the detail analysis and identifying the best solution to achieve the "Objective of Improvement". Thus, your task will involved in explaining and clarifying all the questions related to the manufacturing system design, which is listed below.

S1. [a] Berdasarkan maklumat kajian kes;

i) Kira berapakah untung bersih LESB untuk tahun 2006.
ii) Berapakah purata jumlah komponen yang telah dihasilkan oleh LESB untuk satu hari berdasarkan prestasi tahun 2006?
iii) Berapakah jumlah purata jam kerja lebih masa untuk satu hari bagi tahun 2006?
iv) Kira berapakah jumlah permintaan komponen untuk tahun 2007.
v) Nyatakan sistem pengeluaran yang sedang digunakan oleh LESB.

Based from the information of the case study;

i) Calculate the net profit of LESB for year 2006.
ii) What is the average number of component that LESB had produced in a day based on the year 2006 performance?
iii) What is the total average of overtime hours for one day in year 2006?
iv) Calculate what is the total demand of components for year 2007.
v) State the production system that is currently employ by LESB.

(50 markah)

[b] Berikan EMPAT (4) cadangan tambahan selain daripada yang telah dinyatakan dalam kajian kes untuk memperbaiki prestasi LESB.

Please give FOUR (4) additional suggestions that is different from the case study to improve the LESB performance.

(50 markah)

S2. **Anda telah menyediakan satu skala perbandingan seperti yang ditunjukkan pada jadual S2 bagi tujuan menganalisa data yang dikumpul menggunakan "Analytical Hierarchy Process" (AHP) maka;**

You have come up with a standard preference scale as per shown in table Q2 so that the data can be analyse using Analytical Hierarchy Process (AHP), therefore;

Jadual S2
Table Q2

TAHAP KEUTAMAAN (PREFERENCE LEVEL)	SKALA (SCALE)
Sama-sama diutamakan (Equally Preferred)	1
Keutamaan sederhana (Moderately preferred)	2
Lebih diutamakan (Strongly preferred)	3
Sangat diutamakan (Very strongly preferred)	4
Amat diutamakan (Extremely preferred)	5

[a] **Berdasarkan maklumat cadangan dari PF (rujuk seksyen 5.0) yang telah diberikan dalam kajian kes, bina matrik keutamaan untuk;**

i) Pembekal
ii) Kriteria pembekal

Based form the suggestion information from PR (refer to section 5.0) given in the case study, construct the matrik of preference for;

i) Vendor
ii) Criteria of the vendor

(40 markah)

[b] **Berpandukan matrik keutamaan pada soalan S2[a]i dan S2[a]ii, tunjukkan perincian pengiraan ke atas tiap-tiap matrik tersebut untuk mendapatkan mata skor bagi setiap pembekal dan berikan penarafan pembekal. Syorkan kepada PF, pembekal yang mana patut dipilih.**

Based on the matrix preference in question Q2[a]i and Q2[a]ii, show the detail calculation for each matrix in order to obtain the score for each vendor and rank them orderly. Suggest to PF which supplier should be selected.

(60 markah)

S3. [a] **Berdasarkan maklumat kajian kes dan data analisa yang telah diperolehi daripada S1 dan S2, bagaimanakah LESB dapat memenuhi tambahan permintaan 50% tanpa membuat tambahan kapasiti dari segi pembelian mesin baru. Sila kemukakan bukti pengiraan untuk menguatkan hujah anda.**

Based on the information of the case study and the data analyse from Q1 and Q2, how can LESB meet the increase of 50% demand without additional capacity i.e. buying new machine. Please show the calculation to support your facts.

(50 markah)

[b] **Berdasarkan maklumat kajian kes dan data analisa yang telah diperolehi daripada S1 dan S2, bagaimanakah LESB dapat memenuhi tambahan permintaan 50% sekiranya membuat pembelian mesin LBM. Sila kemukakan bukti pengiraan berikut untuk menguatkan hujah anda;**

i) Anggaran masa mendulu untuk menghasilkan komponen dengan kerja lebih masa.
ii) Apakah tempoh bayaran balik pelaburan membeli mesin LBM?

Based on the information of the case study and the data analyse from Q1 and Q2, how can LESB meet the increase of 50% demand with the purchase of the LBM machine. Please give the following calculate proof to support your facts;

i) Expected lead-time to produced the component the with overtime.
ii) What is the payback period for the investment of the LBM machines(s).

(50 markah)

Bahagian B (*Section B*): Sila jawab DUA (2) soalan sahaja pada bahagian ini.

S4. [a] **Pengurusan Pengeluaran secara fundamentalnya mempunyai dua prosedur utama. Terangkan apakah fasa-fasa dan isu-isu yang diuruskan dengan merujuk kepada syarikat pembuatan.**

Production management fundamentally consists of two main procedures. Explain with reference to a manufacturing company what are the phases and issues that these procedures deal with?

(30 markah)

[b] **Sebuah model adalah persembahan abstrak dari keadaan sebenar atau tingkahlaku dengan bahasa atau ekspresi yang sesuai. Bincangkan bagaimana model boleh dipersembahkan dari perspektif rekabentuk sistem.**

A model is an abstract representation of the real situation or behavior with suitable language or expression. Discuss how the model can be represented from the system design perspective.

(20 markah)

[c] **Bincangkan dengan terperinci kenapa seorang jurutera pembuatan perlu mempunyai kefahaman asas di dalam kaedah rekabentuk sistem sebelum sebuah sistem boleh dibangunkan dan diperbaharui. Kamu boleh memfokuskan perbincangan dari sudut kepentingan, masalah berbangkit dan aspek pertimbangan rekabentuk sistem.**

Discuss in detail why a manufacturing engineer needs to have a basic understanding of the system design approach before a system can be developed or redesigned. Your can focus your discussion on the importance, problems concerns and considerations aspect of system design.

(50 markah)

S5. **Anda telah dilantik sebagai seorang jurutera pembuatan di Syarikat A. Tugasan pertama anda adalah untuk merekabentuk semula susunatur pengeluaran syarikat tersebut. Mengikut kajian anda, pelbagai penukaran akan berlaku dan anda telah memutuskan untuk menggunakan kaedah "Systematic Layout Planning (SLP)" bagi merekabentuk semula susunatur tersebut.**

You have been appointed as an manufacturing engineer at Company A. Your first task is to redesign the production layout of the company. Based on your study, a considerable number of changes will take place and you have decided to utilise the Systematic Layout Planning (SLP) procedure to redesign the layout.

[a] **Sebelum anda boleh memulakan proses merekabentuk semula pemahaman mengenai kriteria susunatur adalah penting. Bincangkan secara terperinci kriteria susunatur yang perlu di fahami sebelum beliau boleh menjalankan proses merekabentuk susunatur.**

Before you can starts the redesign process, an understanding of the layout criteria is essential. Discuss in details the layout criteria that a manufacturing engineer needs to be familiar with before he/she can embark in the layout redesign process.

(50 markah)

[b] **Senarai dan bincangkan secara terperinci maklumat yang perlu dikumpulkan bagi membolehkan proses pembaharuan susunatur dijalankan dengan sistematik dan lancar.**

List and discuss in detail the information that needs to be gathered in order to perform the layout redesign process systematically and effectively.

(50 markah)

S6. **Satu pengeluar komponen kereta bercadang untuk memperkenalkan beberapa jenis produk baru. Kemampuan pengeluaran sekarang masih boleh memenuhi peningkatan pengeluaran kecuali bagi 17 komponen utama. Jabatan Pemasaran mengusulkan kuantiti keperluan komponen pada permulaan untuk setahun adalah berjumlah 21,400 unit dan akan meningkat kepada 45,000 unit setahun selepas tiga tahun. Dari semasa ke masa permintaan adalah turun-naik yang meningkat kepada 500 unit untuk setiap tempahan. Syarikat tersebut juga bertanggungjawab untuk membekalkan komponen gantian, yang mana kuantitinya boleh mencecah 5 ke 20 unit untuk satu kelompok. Tempahan untuk kelompok komponen gantian selalunya dianggap penting apabila diterima.**

Oleh itu, untuk memenuhi permintaan produk baru dan komponen gantian, syarikat tersebut sedang menimbang untuk mendapatkan pelbagai mesin automatik dan konvensional seperti pelarik, pemilan, pencanai dan gergaji pemotong untuk tujuan penghasilan komponen tersebut. Tentukan jenis susunatur yang perlu digunakan oleh syarikat dan berikan sebab kenapa ianya dipilih.

A car component manufacturer is proposing to introduce a new range of products. The existing manufacturing capability is not able to cope with the increases production except for the 17 major products. The marketing department suggested that the components will be required in quantities of 21,400 units per annum initially, to 45,000 per annum after three years. From time to time the demand will be cyclic where the batch can increase up to 500 units for an order. The company is also responsible for the supply of spare part, which may be in batch of five to twenty units. The orders for the spare parts usually are treated as urgent batches when it is received.

In order to fulfill the demands of new product and spare part requirement, the company is considering acquiring various types of automated and conventional machines such as lathe, drilling, grinding and sawing for manufacturing the components. Determine the choice for type of layout that the company should adopt and give the reason for your choice.

(100 markah)

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